

December 19, 2005

LTR: BYRON 2005-0153
File: 1.10.0101

United States Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Subject: Licensee Event Report (LER) 455-2005-001-00, "Unit 2 Automatic Reactor Trip
Due to Low Steam Generator Level Resulting from a Software Fault on the
Turbine Control Power Runback Feature"

Byron Station, Unit 2
Facility Operating License No. NPF-66
NRC Docket No. STN 50-455

Enclosed is an LER concerning the Byron Station Unit 2 automatic reactor trip that occurred on October 19, 2005. This condition is reportable to the NRC in accordance with 10 CFR 50.73 (a) (2) (iv) (A).

Should you have any questions concerning this matter, please contact Mr. William Grundmann, Regulatory Assurance Manager, at (815) 406-2800.

Respectfully,

Stephen E. Kuczynski
Site Vice President
Byron Nuclear Generating Station

SEK/JL/rah

Attachment LER 455-2005-001-00

NRC FORM 366 (6-2004)	U.S. NUCLEAR REGULATORY COMMISSION	APPROVED BY OMB: NO. 3150-0104 EXPIRES: 06/30/2007 Estimated burden per response to comply with this mandatory collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records and FOIA/Privacy Service Branch (T-5 F52), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollect@nrc.gov , and to the Desk Officer, Office of Information and Regulatory Affairs, NEOF-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.
<h2 style="margin: 0;">LICENSEE EVENT REPORT (LER)</h2> <p style="margin: 10px 0;">(See reverse for required number of digits/characters for each block)</p>		
1. FACILITY NAME Byron Station, Unit 2	2. DOCKET NUMBER 05000455	3. PAGE 1 of 4

4. TITLE Unit 2 Automatic Reactor Trip Due to Low Steam Generator Level resulting from a Software Fault on the Turbine Control Power Runback Feature											
5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED		
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER	
10	19	2005	2005	- 001 -	00	12	19	2005	Byron Station, Unit 1	05000454	
									FACILITY NAME	DOCKET NUMBER	
									N/A	N/A	
9. OPERATING MODE		11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR§: <i>(Check all that apply)</i>									
1		<div style="display: flex; flex-wrap: wrap;"> <div style="width: 50%;"><input type="checkbox"/> 20.2201(b)</div> <div style="width: 50%;"><input type="checkbox"/> 20.2203(a)(3)(i)</div> <div style="width: 50%;"><input type="checkbox"/> 50.73(a)(2)(i)(C)</div> <div style="width: 50%;"><input type="checkbox"/> 50.73(a)(2)(vii)</div> <div style="width: 50%;"><input type="checkbox"/> 20.2201(d)</div> <div style="width: 50%;"><input type="checkbox"/> 20.2203(a)(3)(ii)</div> <div style="width: 50%;"><input type="checkbox"/> 50.73(a)(2)(ii)(A)</div> <div style="width: 50%;"><input type="checkbox"/> 50.73(a)(2)(viii)(A)</div> <div style="width: 50%;"><input type="checkbox"/> 20.2203(a)(1)</div> <div style="width: 50%;"><input type="checkbox"/> 20.2203(a)(4)</div> <div style="width: 50%;"><input type="checkbox"/> 50.73(a)(2)(ii)(B)</div> <div style="width: 50%;"><input type="checkbox"/> 50.73(a)(2)(viii)(B)</div> <div style="width: 50%;"><input type="checkbox"/> 20.2203(a)(2)(i)</div> <div style="width: 50%;"><input type="checkbox"/> 50.36(c)(1)(i)(A)</div> <div style="width: 50%;"><input type="checkbox"/> 50.73(a)(2)(iii)</div> <div style="width: 50%;"><input type="checkbox"/> 50.73(a)(2)(ix)(A)</div> <div style="width: 50%;"><input type="checkbox"/> 20.2203(a)(2)(ii)</div> <div style="width: 50%;"><input type="checkbox"/> 50.36(c)(1)(ii)(A)</div> <div style="width: 50%;"><input checked="" type="checkbox"/> 50.73(a)(2)(iv)(A)</div> <div style="width: 50%;"><input type="checkbox"/> 50.73(a)(2)(x)</div> <div style="width: 50%;"><input type="checkbox"/> 20.2203(a)(2)(iii)</div> <div style="width: 50%;"><input type="checkbox"/> 50.36(c)(2)</div> <div style="width: 50%;"><input type="checkbox"/> 50.73(a)(2)(v)(A)</div> <div style="width: 50%;"><input type="checkbox"/> 73.71(a)(4)</div> <div style="width: 50%;"><input type="checkbox"/> 20.2203(a)(2)(iv)</div> <div style="width: 50%;"><input type="checkbox"/> 50.46(a)(3)(ii)</div> <div style="width: 50%;"><input type="checkbox"/> 50.73(a)(2)(v)(B)</div> <div style="width: 50%;"><input type="checkbox"/> 73.71(a)(5)</div> <div style="width: 50%;"><input type="checkbox"/> 20.2203(a)(2)(v)</div> <div style="width: 50%;"><input type="checkbox"/> 50.73(a)(2)(i)(A)</div> <div style="width: 50%;"><input type="checkbox"/> 50.73(a)(2)(v)(C)</div> <div style="width: 50%;"><input type="checkbox"/> OTHER</div> <div style="width: 50%;"><input type="checkbox"/> 20.2203(a)(2)(vi)</div> <div style="width: 50%;"><input type="checkbox"/> 50.73(a)(2)(i)(B)</div> <div style="width: 50%;"><input type="checkbox"/> 50.73(a)(2)(v)(D)</div> </div>									
10. POWER LEVEL											
100											
12. LICENSEE CONTACT FOR THIS LER											
NAME William Grundmann, Regulatory Assurance Manager									TELEPHONE NUMBER (Include Area Code) (815) 406-2800		
13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT											
CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX		
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
14. SUPPLEMENTAL REPORT EXPECTED									15. EXPECTED SUBMISSION DATE		
<input type="checkbox"/> YES (If yes, complete 15. EXPECTED SUBMISSION DATE)									<input checked="" type="checkbox"/> NO		
									MONTH	DAY	YEAR
ABSTRACT <i>(Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)</i>											
<p>On October 19 2005, attempts to execute an automatic Turbine Runback in response to a trip of a Condensate/Condensate Booster (CD/CB) Pump were ineffective and ultimately resulted in an automatic Reactor Trip on low Steam Generator Level. The root cause was determined to be the failure of the Digital Electro-Hydraulic system to automatically runback the turbine as designed. This was due to an application software fault. The software fault effectively rendered all automated Turbine Runbacks inoperable. Corrective actions include the development of procedural controls to monitor and identify software issues of this nature. There were no safety consequences impacting plant or public safety as a result of this event. The automatic turbine runback feature is a non-safety related design feature and is not credited in any Updated Final Safety Analysis Report chapter 15 accident and transient analyses. The actuation of the reactor protection system was reported to the NRC in accordance with 10CFR 50.72 (b)(2)(iv)(B) and 10 CFR 50.73 (a)(2)(iv)(A).</p>											

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
Byron Station, Unit 2	05000455	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	2 OF 4
		2005	- 001	- 000	

NARRATIVE (If more space is required, use additional copies of NRC Form 366A) (17)

A. Plant Condition Prior to Event:

Event Date/Time: October 19, 2005 / 0057 hours CST

Unit 2 - Mode 1 – Power Operations, Reactor Power 100%

Reactor Coolant System [AB]: Normal operating temperature and pressure.

Byron Station Unit 2 has four Condensate/Condensate Booster Pumps (CD/CB) [SD] (i.e., 2A, 2B, 2C, and 2D). Normally, three pumps are necessary to sustain Steam Generator levels at full power operations. An automatic reactor trip will occur when Steam Generator levels dropped to 36.3%. On October 18, 2005 the 2D CD/CB Pump was removed from service for planned maintenance. No other structures, systems or components were inoperable at the start of the event that contributed to this event.

B. Description of Event:

In Byron Station Unit 1 and Unit 2's recent refuel outages in Spring and Fall 2005, respectively, a Digital Electro-Hydraulic (DEH) [JJ] control system for the main turbine was replaced with a more reliable fault tolerant Westinghouse/Emerson Ovation based distributed control system.

During the pre-installation acceptance testing of this DEH control system, a logic fault was unknowingly introduced into the software logic by the vendor that defeated the automatic turbine power runback feature.

The fault was found to be self-correcting under specific circumstances. All of the subject software functions had been exhaustively tested prior to and after installation. The intermittent and periodic nature of the software fault allowed the system software to pass all functional testing without issue.

At 0053 hours on October 19, 2005, the 2A CD/CB Pump tripped. With only two of the four CD/CB pumps operating, Steam Generator levels began to decline. The control room operators entered operating procedure for a CD/CB pump trip (i.e., 2BOA SEC-1), which directed an automatic turbine runback to 700 MWe using the DEH system by pressing the condensate (CD) feedwater (FW) START runback soft key or the Turbine Runback Pushbutton.

The Unit 2 (U2) Operator (licensed) initially pushed the CD/FW STOP runback soft key button instead of the start button. Approximately 23 seconds later, the error was realized and the correct Turbine Runback button was pressed. The turbine runback did not occur. The U2 Operator did not realize the expected response was not occurring until approximately 1 minute later. The U2 Operator now pressed the START runback soft key. The Unit 1 (U1) Supervisor (licensed), aiding the U2 operating crew, recognized that no runback was occurring and informed the U2 Operator. With the automatic runback feature of DEH malfunctioning, the U1 supervisor recommended the turbine be taken to manual control and to manually throttle the governor valves close.

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NARRATIVE (If more space is required, use additional copies of NRC Form 366A) (17)

B. Description of Event: (cont.)

At this time, a restart attempt by another Operator (licensed) on the 2A CD/CB pump was unsuccessful. The U2 Operating crew decided that the reactor would be manually tripped if Steam Generator levels reached 40%.

The U2 Operator recommended to the U2 Supervisor and Shift Manager that the turbine be taken to manual control and manually reduce governor valve position, which is contrary to procedural guidance in 2BOA-SEC-1 on actions to take if the directed action (i.e., the automatic turbine runback) does not occur. The U2 Operator believed that with the DEH system malfunctioning, this procedural guidance would not be effective. The Shift Manager approved this action and the U2 Operator placed DEH in manual and began closing the governor valves. The U2 Operator chose a rapid close feature due to the urgency to reduce power and match steam and feedwater flow to stabilize steam generator levels.

The dynamic effect of this rapid reduction of power on the secondary system caused an increase in Steam Generator pressure, which further inhibited the feedwater flow to the Steam Generators and exacerbated Steam Generator level shrink. Consequently, there was insufficient time to reverse the Steam Generator level decline. Noting that the Steam Generator reactor trip low level had reached 40%, a manual reactor trip was authorized. The U2 Operator was in the process of manually tripping the reactor, when the reactor automatically tripped one second prior to the manual trip initiation. The reactor trip occurred at 0057 hours on October 19, 2005. This was approximately 4 minutes after the initiating event.

As expected, an automatic Auxiliary Feedwater initiation and Feedwater Isolation also occurred due to the low level in the steam generators.

All plant systems functioned as expected in response to the reactor trip. The actuation of the reactor protection system was reported to the NRC in accordance with 10CFR 50.72 (b)(2)(iv)(B) and 10 CFR 50.73 (a)(2)(iv)(A).

C. Cause of Event:

The root cause was determined to be the failure of the DEH system to automatically runback the turbine as designed. This was due to an application software fault, which periodically deleted algorithms associated with the Runback Target Comparator Permissives. The loss of these algorithms effectively rendered all automated Turbine Runbacks inoperable.

The initiating event of the 2A CD/CB pump trip was caused by a stator winding failure. The motor was shipped to the Vendor to further investigate and determine the cause of the failure.

The root cause evaluation also determined that a latent error existed in 2BOA-SEC-1 and the procedure would not have worked as written.

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FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
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		2005	- 001	- 000	

NARRATIVE (If more space is required, use additional copies of NRC Form 366A) (17)

D. Safety Analysis:

There were no safety consequences impacting plant or public safety as a result of this event. The automatic turbine runback feature is a non-safety related design feature and is not credited in any Updated Final Safety Analysis Report chapter 15 accident and transient analyses. The reactor trip system functioned as designed and shutdown the reactor without incident. The 3rd quarter 2005, Unit 2 NRC performance indicator for unplanned scrams per 7000 critical hours is in the green band at a value of zero. With this reactor trip the indicator will still be well within the green band. A PRA analyses also indicates this event was not risk significant.

E. Corrective Actions:

The software fault was repaired on Unit 2. The DEH upgrade was installed on Unit 1 in the Spring 2005 refuel outage with the same software faults. However, the automatic turbine runback feature was never challenged. The software was also corrected on Unit 1.

Procedural guidance will be developed to ensure the Ovation based systems have not been compromised by the introduction of undetected software errors. This process will be applicable to current and future Ovation based upgrades.

Procedural guidance will be developed within the modification process to ensure that lessons learned from this event will be applied to other digital upgrades.

This event will be presented as a human performance case study to applicable operations personnel.

The vendor has also conducted a root cause evaluation and has and will take appropriate corrective actions within their programs and processes. These corrective actions will be evaluated by Exelon and considered for implementation.

1BOA-SEC-1 and 2BOA-SEC-1 have been revised to provide correct procedural guidance when a turbine runback does not occur.

F. Previous Occurrences:

There have been no previous occurrences of this nature.